UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Kedua
Sidang Akademik 2005/2006

April/Mei 2006

EBB 202/3 - Kristalografi & Ikatan Dalam Pepejal

Masa : 3 jam

Sila pastikan bahawa kertas peperiksaan ini mengandungi LIMA muka surat beserta DUA muka surat (Lampiran) yang bercetak sebelum anda memulakan peperiksaan.

Kertas soalan ini mengandungi TUJUH soalan.

Kertas soalan ini mengandungi BAHAGIAN A, BAHAGIAN B dan BAHAGIAN C. Semua soalan di BAHAGIAN A adalah WAJIB dijawab. Calon hendaklah menjawab DUA soalan dari BAHAGIAN B dan DUA soalan dari BAHAGIAN C. Jawab LIMA soalan. Jika calon menjawab lebih daripada lima soalan hanya lima soalan pertama mengikut susunan dalam skrip jawapan akan diberi markah.

Jika calon menjawab SOALAN 2 dan 4, LAMPIRAN 1 dan 2 hendaklah disertakan bersama-sama dengan buku jawapan.

Mulakan jawapan anda untuk setiap soalan pada muka surat yang baru.

Semua soalan mesti dijawab dalam Bahasa Malaysia.

...2/-

BAHAGIAN A

1. [a] Terangkan secara ringkas mengenai yang berikut:

(i) Model Atom

(ii) Kumpulan Simetri Titik

(iii) Kumpulan Simetri Ruang

(50 markah)

[b] Terangkan mekanisma penyerapan sinar-X dan tuliskan persamaan bagi keamatan alur sinar-X yang melalui satu bahan homogen berjarak x.

(30 markah)

[c] Sebanyak separuh keamatan sinar-X homogen telah ditapis oleh penapis aluminium berketebalan 10 mm. Kirakan pecahan sinaran ini jika 20 mm aluminium digunakan.

(20 markah)

...3/-

BAHAGIAN B

2. [a] Terangkan (beserta lakaran yang jelas) mengenai elemen-elemen simetri (termasuk simetri peralihan) yang terlibat dalam membangunkan kumpulan simetri titik dan simetri ruang.

(50 markah)

[b] Lukis imej penuh bagi unjuran stereografik yang diberi dalam **Lampiran 1**.

(50 markah)

3. [a] Apakah kepentingan kumpulan simetri titik dan kumpulan simetri ruang dalam pencirian hablur? Jelaskan bagaimana **KEDUA-DUA** kumpulan simetri tersebut dapat dibangunkan.

(70 markah)

[b] Berikan persamaan am gelombang Schrödinger dan apakah yang dimaksudkan dengan rangkap gelombang, ψ, dan ψ^2. Apakah yang diberikan oleh penyelesaian persamaan ini?

(30 markah)

4. [a] Lukiskan atau tandakan elemen-elemen simetri yang dipunyai oleh hablur-hablur yang diberikan dalam **Lampiran 2**. Dalam kumpulan simetri titik manakah hablur-hablur tersebut tergolong?

(60 markah)

[b] Setiap bahan hablur menunjukkan sifat-sifat yang berbeza di antara satu sama lain dan terdapat beberapa sifat bahan yang mempunyai kaitan langsung dengan jenis ikatan dalam hablur.

(i) Jelaskan jenis-jenis ikatan pepejal.

(ii) Apakah sifat-sifat bahan yang berkait dengan jenis ikatan?

(iii) Bagaimanakah ikatan dalam pepejal mempengaruhi sifat-sifat tersebut?

(40 markah)

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BAHAGIAN C

5. [a] Terangkan perbezaan mekanisma penghasilan sinar-X dan penghasilan kesan foton.

(80 markah)

[b] Kirakan frekuensi ambang (λ_K) dalam unit Å bagi sinar-X yang dihasilkan oleh 50 keV elektron dalam tiub perlanggaran.
[Diberi h = 6.63 x 10^{-34} J.s, c = 3 x 10^8 m/s, e = 1.6 x 10^{-19} J/eV]

(20 markah)

6. Plotkan graf keamatan (I/I_1) lawan sudut serakan (2θ) untuk Nikel (Ni) berdasarkan Fail Data Serbuk Sinar-X JCPDS (lihat Rajah 1).

(100 markah)

4-0850 MINOR CORRECTION

d 4-0850	2.03	1.76	1.25	2.034	Ni
I/I$_1$ 4-0850	100	42	21	100	Nickel

Rad. CuKα λ 1.5405 Filter Ni
Dia. Cut off Coll.
I/I$_1$ G. C. Diffractometer d corr. abs.?
Ref. Swanson and Tatge, JC Fel. Reports, NBS 1951

Sys. Cubic S.G. O_h^5 - Fm3m
a_o 3.5238 b_o c_o A C
α β γ Z 4
Ref. Ibid.

εα nωβ εγ Sign
2V Dx 8.907 mp Color
Ref.

Spectrographic analysis shows <0.01% each of Mg, Si and Ca.
At 26°C
To replace 1-1258, 1-1260, 1-1266, 1-1272, 3-1043, 3-1051

d Å	I/I$_1$	hkl	d Å	I/I$_1$	hkl
2.034	100	111			
1.762	42	200			
1.246	21	220			
1.0624	20	311			
1.0172	7	222			
0.8810	4	400			
.8084	14	331			
.7880	15	420			

Rajah 1 - Fail Data Sinar-X JCPDS bagi Nikel.

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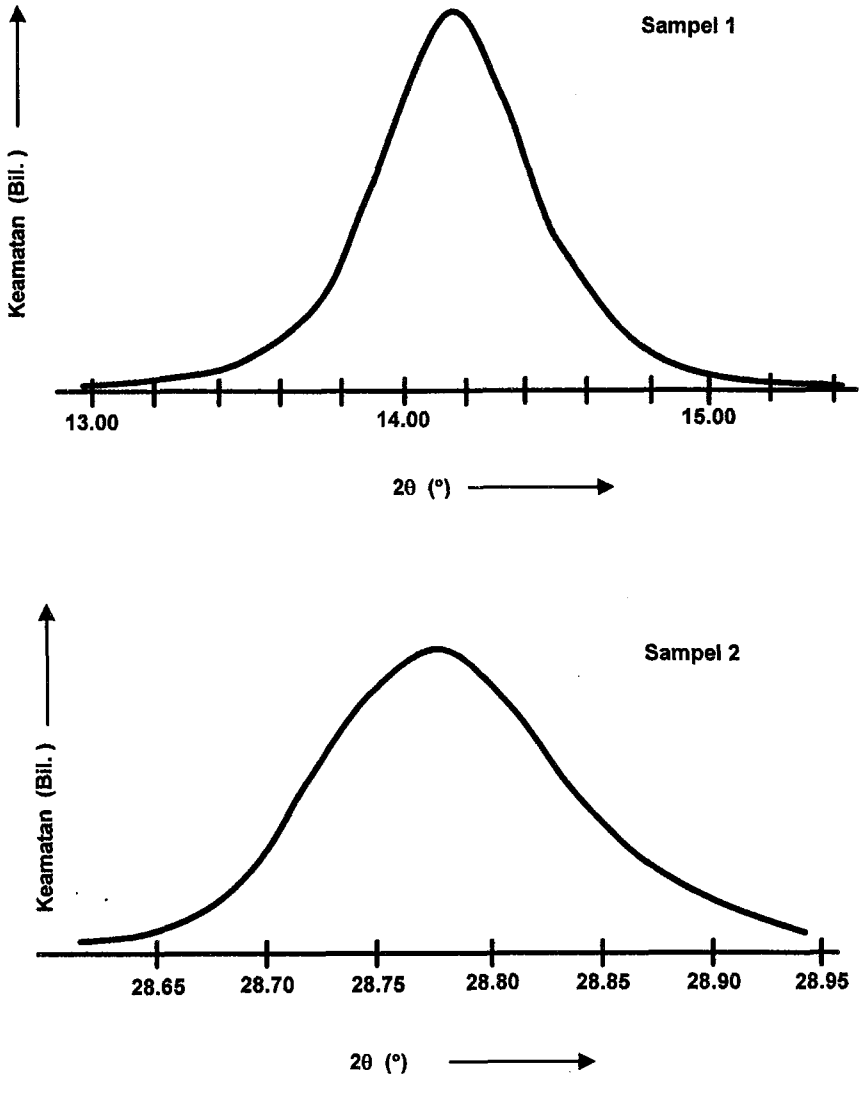
7. [a] Terbitkan formula Scherrer.

(50 markah)

[b] Rajah 2 menunjukkan dua puncak XRD bagi polimer-garam terkompleks. Kirakan panjang Scherrer dan tentukan sampel yang mana mempunyai darjah kristal yang tinggi. [Diberi λ = 1.5418Å]

(50 markah)



Rajah 2 - Puncak-puncak XRD bagi polimer-garam terkompleks

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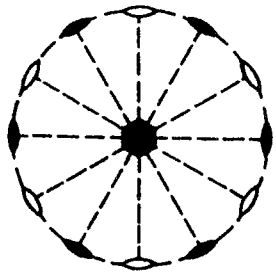
LAMPIRAN 1

(i)



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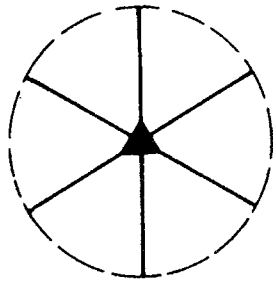
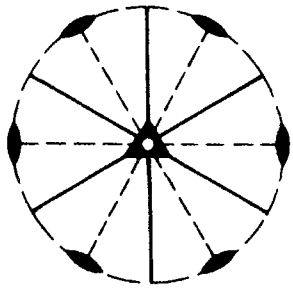
(ii)



3 *m*

(iii)



$\bar{3}\ \frac{2}{m}\ \frac{2}{m}$

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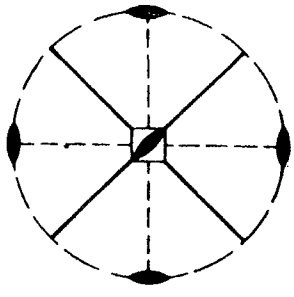

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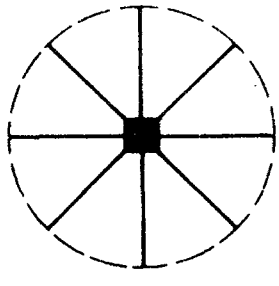

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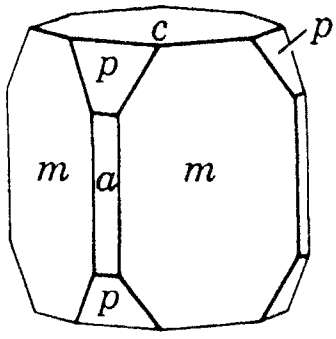
LAMPIRAN 2

(i)



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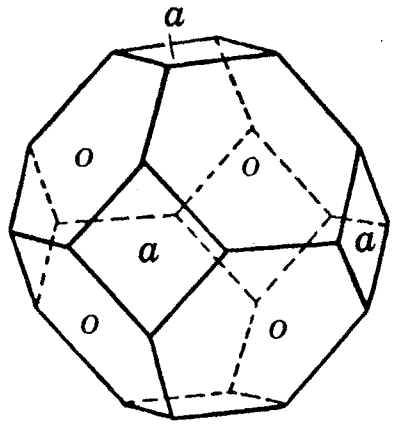

Hablur Kuprit

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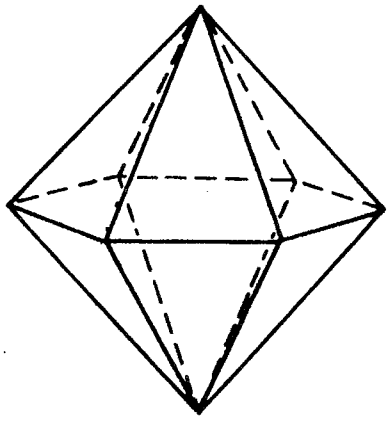

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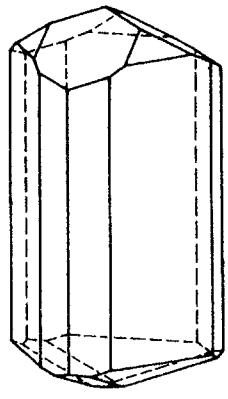

Tormalin

TRANSLATION

UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session of 2005/2006

April/May 2006

EBB 202/3 - Crystallography & Bonding in Solids

Time : 3 hours

Please check that this examination paper consists of FIVE pages of printed material and TWO pages APPENDIX before you begin the examination.

This paper contains SEVEN questions.

This paper contains SECTION A, SECTION B and SECTION C. Answer all questions from SECTION A. Answer TWO questions from SECTION B and TWO questions from SECTION C. Answer any FIVE questions. If a candidate answers more than five questions, only the first five answered will be examined and awarded marks.

If you answer QUESTION 2 and 4, APPENDIX 1 and 2 must be attached together with the answer script.

Answer to any question must start on a new page.

All questions must be answered in Bahasa Malaysia.

...2/-

PART A

1. [a] Explain briefly about the following:

(i) Atomic Model

(ii) Point Group Symmetry

(iii) Space Group Symmetry

(50 marks)

[b] Explain the mechanisms of X-rays absorption and write down an expression for the intensity of X-ray beam as it passes through x distance any homogeneous substance.

(30 marks)

[c] One-half the intensity of a homogeneous X-ray beam is removed by aluminium filter 10 mm thick. Calculate the fraction of this homogeneous beam that would be removed by 20 mm of aluminium.

(20 marks)

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PART B

2. [a] Explain (with clear sketch/drawing) about the symmetry elements (including translational symmetry) involved in developing point group symmetry and space group symmetry.

(50 marks)

[b] Draw the full image for the stereographic projection given in **Appendix 1**.

(30 marks)

3. [a] What is the importance of point group symmetry and space group symmetry in the characterization of crystals? Explain how **BOTH** symmetry groups can be developed.

(70 marks)

[b] Give the Schrödinger wave equation and what is meant by wave function ψ and ψ^2. What does the solved equation gives?

(30 marks)

4. [a] Draw or labeled the symmetry elements that all the crystals given in **Appendix 2** possessed. In which point group symmetry does the crystals belong to?

(60 marks)

[b] All crystal materials showed different properties from one to the other and there are a few properties which directly related to the type of bonding in crystal.

(i) Explain the types of bonding in solid.

(ii) What are the properties related to types of bonding?

(iii) How does the bonding in solid influence those properties?

(40 marks)

...4/-

PART C

5. [a] Explain the difference in the mechanism to produces X-rays and photon effect.

(80 marks)

[b] Determine the cut-off wavelength (λ_K) in unit Å of x-rays produced by 50 keV electron in a Coolidge tube.
[Given h = 6.63 x 10^{-34} J.s, c = 3 x 10^8 m/s, e = 1.6 x 10^{-19} J/eV]

(20 marks)

6. Plot a graph intensity (I/I_1) versus 2θ for Nickel (Ni) based on JCPDS X-Ray Powder Data File (see Figure 1). [Given λ = 1.5418Å]

(100 marks)

4-0850 MINOR CORRECTION

d 4-0854	2.03	1.76	1.25	2.034	Ni
I/I$_1$ 4-0850	100	42	21	100	NICKEL

Rad. CuKα λ 1.5405 Filter Ni
Dia. Cut off Coll.
I/I$_1$ G. C. DIFFRACTOMETER d corr. abs.?
Ref. SWANSON AND TATGE, J. C. FEL. REPORTS, NBS 1951

Sys. CUBIC S.G. O_h^5 - Fm3m
a_o 3.5238 b_o c_o A C
α β γ Z 4
Ref. IBID.

εα nωβ εγ Sign
2V D8.907 mp Color
Ref.

SPECTROGRAPHIC ANALYSIS SHOWS <0.01% EACH OF Mg, Si AND Ca.
AT 26°C
TO REPLACE 1-1258, 1-1260, 1-1266, 1-1272, 3-1043, 3-1051

d Å	I/I$_1$	hkl	d Å	I/I$_1$	hkl
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1.762	42	200			
1.246	21	220			
1.0624	20	311			
1.0172	7	222			
0.8810	4	400			
.8084	14	331			
.7880	15	420			

Figure 1 - Nikel JCPDS X-Ray Powder Data File

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7. [a] Derive the Scherrer's formula.

(50 marks)

[b] Figure 2 shows the XRD peaks of two polymer-salt complexed samples. Calculate the Scherrer length and determine which sample has higher degree of crystallinity. [Given λ = 1.5418Å]

(50 marks)

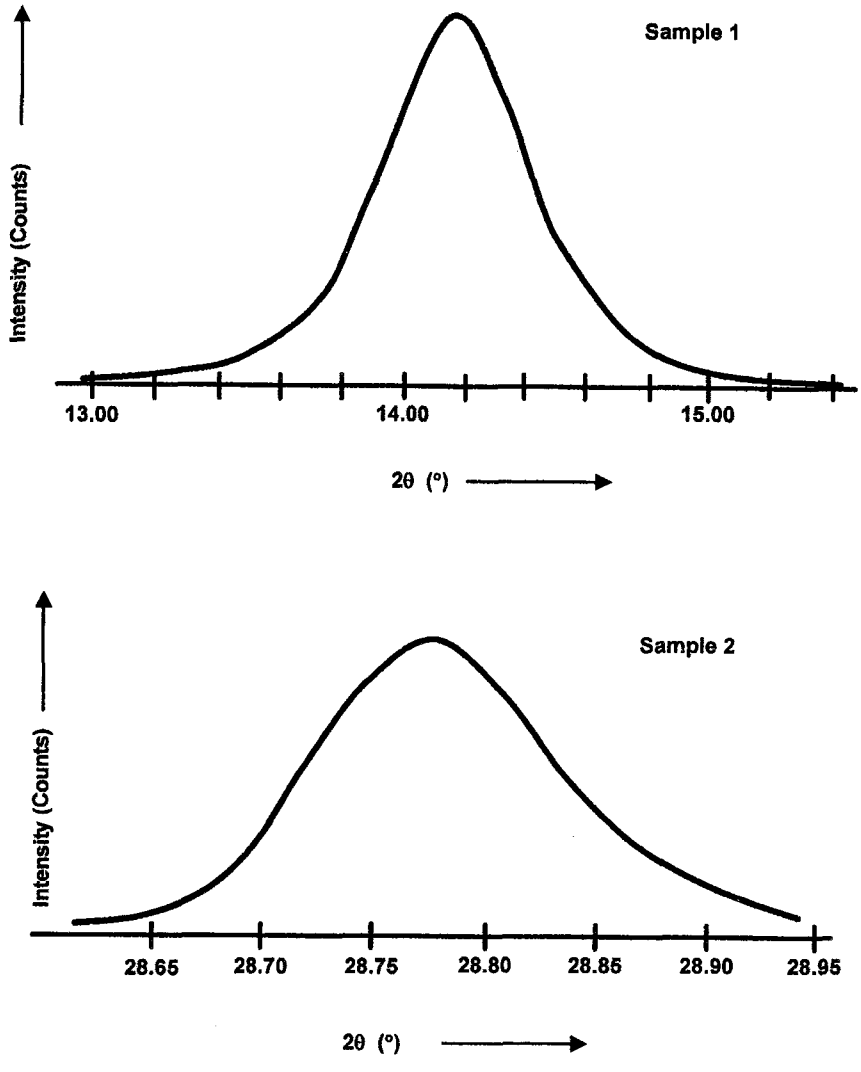

Figure 2 - XRD peaks for polymer-salt complexed

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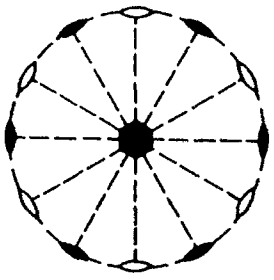
APPENDIX 1

(i)



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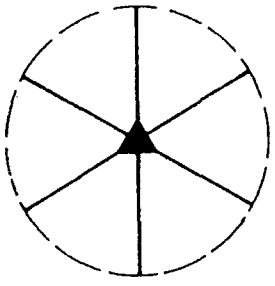

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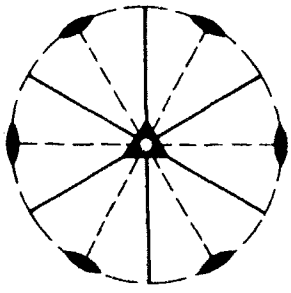
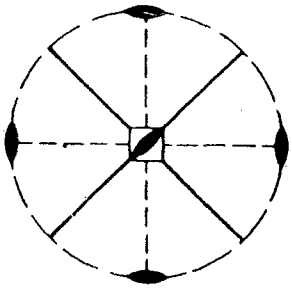
(iii)



$\bar{3}\ \frac{2}{m}\ \frac{2}{m}$

(iv)



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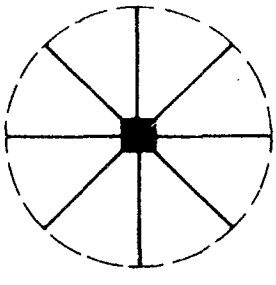

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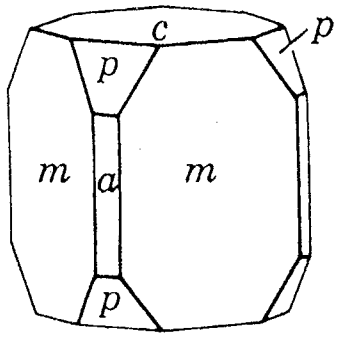
APPENDIX 2

(i)



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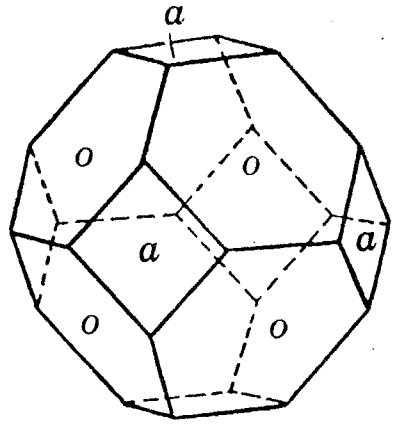
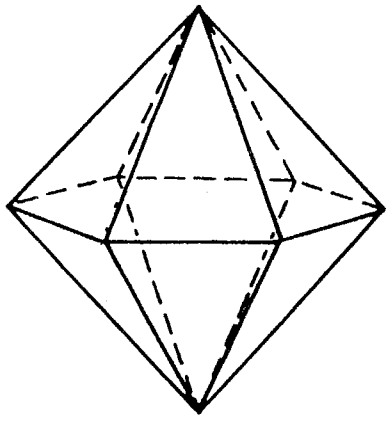


Cuprite Crystals

(iii)



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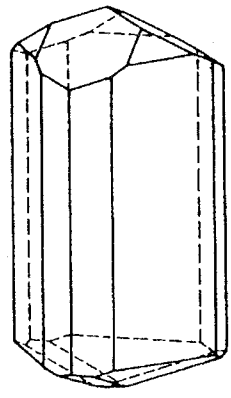
(iv)



Tourmaline